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(54) Title: ERROR CONCEALMENT FOR VIDEO SERVICES

(57) Abstract

    In compressed video signals, lost or erroneous information in a current image signal received at the receiving end of a transmission channel is concealed by identifying a motion compensated equivalent region in a previously transmitted image and substituting the equivalent region as a prediction of the lost or erroneous information in the current image.

ERROR CONCEALMENT FOR VIDEO SERVICES

Introduction

This invention relates to the field of visual services over a
telecommunications network or on a storage system and in particular, the
5   invention provides techniques for improved quality of compressed video
signals when they are subject to loss or error by a telecommunications
network or storage system.

Background

Digital video is of growing importance for many applications,
10   including broadcast television services and interpersonal communications.
There are several important international standards in this area, such as
ISO/IEC MPEG 2 and ITU-T H.324, which enable interworking between a
range of service providers and decoding equipment manufactured by
different companies. These standards provide means for compressing and
15   coding both video and audio data, and a packet-based multiplex that allows
bitstreams from multiple video and/or audio sources to be carried on a single
channel.

Errors introduced in the digital video bitstream by the transmission
system cause the loss of video data, and lead to a range of obnoxious artefacts
20   in the output video sequence unless effective action is taken by the decoder.

Prevention of these artefacts requires that errors be detected, and that
data that is in error or suspected of being in error be discarded. This can be
achieved at the multiplexing layer by discarding packets that contain errors.
Having discarded this data, it is then necessary to resynchronise and restart
25   the decoding process, to localise the error (i.e. minimising propagation of
errors) and to conceal the effects of the error.

Effective concealment is the key to providing a high-quality of service
in the presence of transmission errors. It is also the only aspect of error
resilience that is not defined by international standards. It is therefore
30   necessary for each decoder manufacturer to develop their own methods.

One effective error concealment uses information from a previous
video frame that has been received correctly and also takes into account the
motion between this previous frame and the frame in which the loss has
occurred. This type of concealment is known as "motion-compensated
35   concealment". The key problem in motion-compensated concealment is to

estimate reliably the motion, and it is in this area that previous technology is deficient.

Degradation of quality is also of concern in other image-based services. Archive photographic film, for example, deteriorates over time.

5 Once again, restoration of quality can be achieved in image sequences such as movies by discarding the degraded region and using motion-compensated concealment. Once again, previous technology does not provide sufficiently reliable motion estimation techniques.

Summary of the Invention

10 For the purpose of this specification, the term "video signal" includes all representations of a sequence of pictures, coded in any manner, whether analog or digital, square, rectangular or of any other shape, and compressed or not compressed and including photographic film as well as electrical and mechanical representations.

15 According to a first aspect the present invention provides a video processing system including:

a) error detection means arranged to detect errors in and/or loss of information in a primary video signal and to identify a particular picture and a region within the picture of the primary video signal containing each such

20 error in or loss of information; and

b) video signal processing means for producing a secondary video signal as an error concealed version of the primary video signal, wherein regions of the primary video signal that do not contain errors in or loss of information are copied directly to the secondary signal from the primary

25 signal and in which each error concealed region in the secondary signal corresponding to an error region in the primary signal containing errors in or loss of information is generated by means of motion-compensated prediction from a previous picture in the secondary video signal, the video signal processing means including error concealment means for generating each

30 error concealed region in the secondary signal, the error concealment means being arranged to:

i) identify, in relation to each error region in the primary signal, a primary tag region of the current picture of the secondary signal located in a known location in close proximity to the respective error region;

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ii) scan a previous picture of the secondary signal to locate a secondary tag region substantially identical to each primary tag region of the current picture;

iii) generate error concealed regions of the current picture of the secondary signal by identifying a substitution region located in the same relative location with respect to the secondary tag region as the error region of the current picture of the primary signal is located with respect to the primary tag region; and

iv) copy the substitution region to the respective error region in the current picture of the secondary signal.

According to a second aspect the present invention provides a video processing system including:

a) error detection means arranged to detect errors in and/or loss of information in a primary compressed digital video signal and to identify macroblocks within the primary video signal containing each such error in or loss of information; and

b) video signal processing means for producing a secondary video signal as an error concealed version of the primary video signal, wherein macroblocks within the primary video signal that do not contain errors in or loss of information are copied directly to the secondary signal from the primary signal and in which each error concealed macroblock in the secondary signal corresponding to an erroneous macroblock in the primary signal containing errors in or loss of information is generated by means of motion-compensated prediction from a previous picture in the secondary video signal, the video signal processing means including error concealment means for generating each error concealed macroblock in the secondary signal, the error concealment means being arranged to:

i) identify, in relation to each erroneous macroblock in the primary signal, a primary tag region of the current picture of the secondary signal located in a known location in close proximity to the respective erroneous macroblock;

ii) scan a previous picture of the secondary signal to locate a secondary tag region substantially identical to each primary tag region of the current picture;

iii) generate error concealed macroblocks of the current picture of the secondary signal by identifying a substitution macroblock located in

the same relative location with respect to the secondary tag region as the erroneous macroblock of the current picture of the primary signal is located with respect to the primary tag region; and

5   iv) copy the substitution macroblock to the macroblock in the current picture of the secondary signal corresponding to the respective erroneous macroblock in the primary signal.

According to a third aspect the present invention provides a method of processing a video signal including the steps of:

a) detecting errors in and/or loss of information in a primary video

10   signal and identifying a particular picture and a region within the picture of the primary video signal containing each such error in or loss of information; and

b) producing a secondary video signal as an error concealed version of the primary video signal, wherein regions of the primary video signal that

15   do not contain errors in or loss of information are copied directly to the secondary signal from the primary signal, and each error concealed region in the secondary signal corresponding to an error region in the primary signal containing errors in or loss of information is generated by means of motion-compensated prediction from a previous picture in the secondary video

20   signal, each error concealed region in the secondary signal being generated by the further steps of:

i) identifying, in relation to each error region in the primary signal, a primary tag region of the current picture of the secondary signal located in a known location in close proximity to the respective error region;

25   ii) scanning a previous picture of the secondary signal to locate a secondary tag region substantially identical to each primary tag region of the current picture;

iii) generating error concealed regions of the current picture of the secondary signal by identifying a substitution region located in the same

30   relative location with respect to the secondary tag region as the error region of the current picture of the primary signal is located with respect to the primary tag region; and

iv) copying the substitution region to the respective error region in the current picture of the secondary signal.

35   According to a fourth aspect the present invention provides a method of processing a video signal including the steps of:

a) detecting errors in and/or loss of information in a primary compressed digital video signal and identifying macroblocks within the primary video signal containing each such error in or loss of information; and

b) producing a secondary video signal as an error concealed version
5 of the primary video signal, wherein macroblocks within the primary video signal that do not contain errors in or loss of information are copied directly to the secondary signal from the primary signal and in which each error concealed macroblock in the secondary signal corresponding to an erroneous macroblock in the primary signal containing errors in or loss of information
10 is generated by means of motion-compensated prediction from a previous picture in the secondary video signal, each error concealed macroblock in the secondary signal, being generated by:

i) identifying, in relation to each erroneous macroblock in the primary signal, a primary tag region of the current picture of the secondary
15 signal located in a known location in close proximity to the respective erroneous macroblock;

ii) scanning a previous picture of the secondary signal to locate a secondary tag region substantially identical to each primary tag region of the current picture;
20 iii) generating error concealed macroblocks of the current picture of the secondary signal by identifying a substitution macroblock located in the same relative location with respect to the secondary tag region as the erroneous macroblock of the current picture of the primary signal is located with respect to the primary tag region; and
25 iv) copying the substitution macroblock to the macroblock in the current picture of the secondary signal corresponding to the respective erroneous macroblock in the primary signal.

Brief Description of the Drawings

Embodiments of the present invention will now be described by way
30 of example with reference to the accompanying drawings in which:

Figure 1 illustrates the pixels used in the motion estimation in one embodiment of the present invention.

Figure 2 is a block diagram of an embodiment of the present invention.

Detailed Description of the Preferred Embodiments

35 In the last decade, audio-visual services have grown beyond their traditional applications in broadcast television to include a large range of

interactive services, such as videoconferencing. This growth of point to point, as opposed to broadcast, applications has led to demand from users to reduce the cost of transmitting these services. Fortunately, there have been technological advances that permit higher quality services to be delivered using the same

5   resources, or, alternatively, a service of a given quality to be delivered using less resources (and therefore to be delivered more cheaply). One of the significant advances has been the development of the digital approach, in which both the video and audio signals are represented as a sequence of binary numbers.

When audio-visual services are transmitted on digital communications

10   systems, it is necessary to apply compression techniques in order that the amount of information to be transmitted is not beyond the capacity of the network. These techniques are all based on removing the redundant information. For example, video consists of a sequence of pictures, each of which is represented by a number of pixels. Each pixel represents the

15   brightness and colour information at a particular point in the frame. However, adjacent pixels tend to be very similar. Also, pixels in the same location in different pictures that are closely spaced in time tend be similar. By taking advantage of this 'sameness', it is possible to transmit video information more efficiently. Furthermore, it is not necessary that an exact copy of the video

20   signal be transmitted, since most video contains detail that the human eye cannot see. This observation leads to another method by which compression can be achieved: throwing away information that is not perceptually important.

Most modern video coders use motion estimation to form a motion-compensated prediction of the video frame to be encoded. This technique

25   effectively exploits temporal redundancy within the sequence. Next, the Discrete Cosine Transform (DCT) is employed to small blocks of data (usually 8x8 pixels) within the difference image produced by subtracting the motion compensated prediction from the video frame. The DCT both removes any remaining spatial redundancy in the difference image and also compacts the

30   remaining energy into a relatively few DCT coefficients. The DCT coefficients are then quantised (rounded) and entropy coded (common values are coded with a short codeword while less likely coefficients are coded with longer codewords) prior to transmission to the decoder.

In many applications, errors can be introduced into a video signal when

35   it is either transmitted over a telecommunications network or stored. These

errors cause degradation of the received video quality. This degradation can be significantly reduced by the application of effective concealment techniques.

Embodiments of the present invention aim to accurately estimate the motion vector of any lost macroblocks using correctly received information at

5   the decoder. This is achieved by carrying out a process similar to the motion estimation process performed at the encoder in order to determine the missing motion vector.

When an error or loss of information occurs, pixels surrounding the region of error and/or loss are taken. In the preferred implementation associated

10   with a macroblock-based video coding scheme, two or more lines of information around any lost macroblocks are taken. This includes available information in the macroblock above the lost macroblock, the macroblock to the left of the lost macroblock and the macroblock above and to the left of the lost macroblock (even if these macroblocks are themselves concealed macroblocks). Figure 1

15   illustrates the location of the relevant two lines of pixels in the macroblocks closest to the lost macroblock.

The algorithm then performs a full search within the previous picture for the best match to the available lines of decoded pixels from the current picture in the sense of minimising the mean absolute difference between the

20   pixels in the current and previous frames. The macroblock of data which is surrounded by the lines which best match the lines from the current picture is assumed to be the best match to the lost macroblock. Motion vectors may be estimated to either full or half pixel accuracy. In the preferred implementation, a search to full pixel accuracy is performed first, followed by a search to half

25   pixel accuracy within +/- 0.5 pixel of the best match in the full-pixel search.

This method can be applied to regions of error and/or loss of arbitrary shape. The shape of the region of pixels external to this area may also be of arbitrary shape. The region of pixels used in the search would usually be adjacent to the area or error and/or loss but may be located anywhere in the

30   picture. In the example shown in Figure 1, pixels from the macroblocks below and below and to the left of the lost macroblock could also be used in the motion search, so long as these macroblocks are received correctly.

Implementations of the motion search may use criteria other than minimising the mean absolute difference between pixels in the current and

35   previous frames. Other suitable criteria include minimising mean squared

difference, maximising the cross correlation and maximising the phase correlation.

The method may be simplified by replacing the full search with a fast search technique. In one such technique, only particular candidate motion
5   vectors are investigated:
- the motion vector for the same macroblock in the previous picture;
- the motion vectors associated with available neighbouring macroblocks;
- the median of the available neighbouring macroblocks;
- the average of the available neighbouring macroblocks;
10   - the zero motion vector.

The search is performed at each of these candidate locations in the same manner as each step of the full search.

The block diagram of Figure 2 shows one possible implementation of the principles of the present invention. A video bitstream arrives at the
15   Bitstream Decoder block 11. Motion information and an indication of whether an error or loss has been detected is passed to the Decoder Motion Vector Estimation block 16. Quantised discrete cosine transform coefficients are passed to the Inverse Quantisation block 12.

The Inverse Quantisation block 12 converts the quantised discrete
20   cosine transform coefficients to Discrete Cosine Transform coefficients and passes these coefficients to the Inverse Discrete Cosine Transform block 13.

The Inverse Discrete Cosine Transform block 13 performs the inverse Discrete Cosine Transform operation, and passes data in the pixel domain to the summation block 14. For the ability of the receiver to tolerate errors. For
25   video services, provision of effective error robustness, and especially error concealment, in the decoder permits effective service delivery in otherwise unacceptable propagation conditions. Such an approach has application in both terrestrial broadcast and satellite systems.

Congestion in packet networks, including those based on TCP/IP and
30   the newer ATM technology, can lead to packets being lost or arriving at the decoder too late to be used. Effective error resilience, as provided by the embodiments of the present invention, in a video decoder enables operation in otherwise unacceptable congestion, and potentially reduces the importance of controlling packet loss in network management.

35   Because it is implemented solely in the decoder, the present invention can be implemented in conjunction with any video transmission or

storage system where that video consists of frames, which are two dimensional arrays of pixels. This includes all current standards for video compression and coding, such as ISO/IEC MPEG 1 and MPEG 2 and ITU-T H.261 and H.263. It also includes future standards, such as ISO/IEC MPEG 4.

5   Furthermore, the fact that this technique employs motion estimation and compensation requires neither that the coding used for transmission and/or storage of the video signal employed motion estimation and compensation nor even that this coding was block based.

It will be appreciated by persons skilled in the art that numerous

10   variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS

1.   A video processing system including:

        a) error detection means arranged to detect errors in and/or loss of information in a primary video signal and to identify a particular picture and

5   a region within the picture of the primary video signal containing each such error in or loss of information; and

        b) video signal processing means for producing a secondary video signal as an error concealed version of the primary video signal, wherein regions of the primary video signal that do not contain errors in or loss of

10   information are copied directly to the secondary signal from the primary signal and in which each error concealed region in the secondary signal corresponding to an error region in the primary signal containing errors in or loss of information is generated by means of motion-compensated prediction from a previous picture in the secondary video signal, the video signal

15   processing means including error concealment means for generating each error concealed region in the secondary signal, the error concealment means including:

        i) identification means for identifying, in relation to each error region in the primary signal, a primary tag region of the current picture of the

20   secondary signal located in a known location in close proximity to the respective error region;

        ii) scanning means for scanning a previous picture of the secondary signal to locate a secondary tag region substantially identical to each primary tag region of the current picture;

25   iii) prediction means for generating error concealed regions of the current picture of the secondary signal by identifying a substitution region located in the same relative location with respect to the secondary tag region as the error region of the current picture of the primary signal is located with respect to the primary tag region; and

30   iv) copying means for copying the substitution region to the respective error region in the current picture of the secondary signal.

2.   The video processing system of claim 1 wherein the video signal processing means first generates in the secondary signal those regions that are error free in the primary signal.

3.   The video processing system of claim 2 wherein after the video
processing means has produced the error free regions, it identifies tag regions
in the primary signal relative to each error containing region.

4.   The video processing system of claim 3 wherein for each tag region a
corresponding tag region is identified in the previous picture of the
secondary signal, and a region relative to each tag region is identified as the
motion compensated predication of the respective error region of the current
picture of the primary signal.

5.   The video processing system of claim 4 wherein, for each tag region,
the motion compensated prediction of the corresponding error containing
region is determined before identifying the next tag region.

6.   The video processing system of claim 4 wherein all of the tag regions
are identified before any of the motion compensated predictions are
determined.

7.   The video processing system as claimed in any one of the preceding
claims wherein the error region is divided into a plurality of subregions, each
having a corresponding tag region and a separate motion compensated
prediction being determined for each error containing region.

8.   The video processing system as claimed in any one of the preceding
claims wherein each tag region is immediately adjacent to the respective
error containing region.

9.   The video processing system of claim 8 wherein each tag region
comprises one or more rows of pixels along one or more edges of the
respective error containing region.

10.   A video processing system including:
        a) error detection means arranged to detect errors in and/or loss of
information in a primary compressed digital video signal and to identify
macroblocks within the primary video signal containing each such error in or
loss of information; and
        b) video signal processing means for producing a secondary video
signal as an error concealed version of the primary video signal, wherein
macroblocks within the primary video signal that do not contain errors in or
loss of information are copied directly to the secondary signal from the
primary signal and in which each error concealed macroblock in the
secondary signal corresponding to an erroneous macroblock in the primary
signal containing errors in or loss of information is generated by means of

motion-compensated prediction from a previous picture in the secondary video signal, the video signal processing means including error concealment means for generating each error concealed macroblock in the secondary signal, the error concealment means including:

     i) identification means for identifying, in relation to each erroneous macroblock in the primary signal, a primary tag region of the current picture of the secondary signal located in a known location in close proximity to the respective erroneous macroblock;

     ii) scanning mans for scanning a previous picture of the secondary signal to locate a secondary tag region substantially identical to each primary tag region of the current picture;

     iii) prediction means for generating error concealed macroblocks of the current picture of the secondary signal by identifying a substitution macroblock located in the same relative location with respect to the secondary tag region as the erroneous macroblock of the current picture of the primary signal is located with respect to the primary tag region; and

     iv) copying means for copying the substitution macroblock to the macroblock in the current picture of the secondary signal corresponding to the respective erroneous macroblock in the primary signal.

11. The video processing system of claim 10 wherein the video signal processing means first generates in the secondary signal those regions that are error free in the primary signal.

12. The video processing system of claim 11 wherein after the video processing means has produced the error free regions, it identifies tag regions in the primary signal relative to each error containing macroblock.

13. The video processing system of claim 12 wherein for each tag region a corresponding tag region is identified in the previous picture of the secondary signal, and a region relative to each tag region is identified as the motion compensated predication of the respective error region of the current picture of the primary signal.

14. The video processing system of claim 13 wherein for each tag region the motion compensated prediction of the corresponding error macroblock is determined before identifying the next tag region.

15. The video processing system of claim 13 wherein all of the tag regions are identified before any of the motion compensated predictions are determined.

16.   The video processing system as claimed in any one of claims 10-15
wherein the error containing macroblock is divided into a plurality of
subregions, each having a corresponding tag region and a separate motion
compensated prediction being determined for each error containing
5   macroblock.

17.   The video processing system as claimed in any one of claims 10-16
wherein each tag region is immediately adjacent to the respective error
containing macroblock.

18.   The video processing system of claim 17 wherein each tag region
10   comprises one or more rows of pixels along one or more edges of the
respective error containing macroblock.

19.   A method of processing a video signal including the steps of:

a) detecting errors in and/or loss of information in a primary video
signal and identifying a particular picture and a region within the picture of
15   the primary video signal containing each such error in or loss of information;
and

b) producing a secondary video signal as an error concealed version
of the primary video signal, wherein regions of the primary video signal that
do not contain errors in or loss of information are copied directly to the
20   secondary signal from the primary signal, and each error concealed region in
the secondary signal corresponding to an error region in the primary signal
containing errors in or loss of information is generated by means of motion-
compensated prediction from a previous picture in the secondary video
signal, each error concealed region in the secondary signal being generated
25   by the further steps of:

i) identifying, in relation to each error region in the primary
signal, a primary tag region of the current picture of the secondary signal
located in a known location in close proximity to the respective error region;

ii) scanning a previous picture of the secondary signal to locate
30   a secondary tag region substantially identical to each primary tag region of
the current picture;

iii) generating error concealed regions of the current picture of
the secondary signal by identifying a substitution region located in the same
relative location with respect to the secondary tag region as the error region
35   of the current picture of the primary signal is located with respect to the
primary tag region; and

iv) copying the substitution region to the respective error region in the current picture of the secondary signal.

20. The method of claim 19 wherein the video signal processing means first generates in the secondary signal those regions that are error free in the primary signal.

21. The method of claim 20 wherein after the video processing means has produced the error free regions, it identifies tag regions in the primary signal relative to each error containing region.

22. The method of claim 21 wherein for each tag region a corresponding tag region is identified in the previous picture of the secondary signal, and a region relative to each tag region is identified as the motion compensated predication of the respective error region of the current picture of the primary signal.

23. The method of claim 22 wherein for each tag region the motion compensated prediction of the corresponding error containing region is determined before identifying the next tag region.

24. The method of claim 22 wherein all of the tag regions are identified before any of the motion compensated predictions are determined.

25. The method as claimed in any one of claims 19-24 wherein the error region is divided into a plurality of subregions, each having a corresponding tag region and a separate motion compensated prediction being determined for each error region.

26. The method as claimed in any one of claims 19-25 wherein each tag region is immediately adjacent to the respective error containing region.

27. The method of claim 26 wherein each tag region comprises one or more rows of pixels along one or more edges of the respective error containing region.

28. A method of processing a video signal including the steps of:

a) detecting errors in and/or loss of information in a primary compressed digital video signal and identifying macroblocks within the primary video signal containing each such error in or loss of information; and

b) producing a secondary video signal as an error concealed version of the primary video signal, wherein macroblocks within the primary video signal that do not contain errors in or loss of information are copied directly to the secondary signal from the primary signal and in which each error concealed macroblock in the secondary signal corresponding to an erroneous

macroblock in the primary signal containing errors in or loss of information is generated by means of motion-compensated prediction from a previous picture in the secondary video signal, each error concealed macroblock in the secondary signal, being generated by:

i) identifying, in relation to each erroneous macroblock in the primary signal, a primary tag region of the current picture of the secondary signal located in a known location in close proximity to the respective erroneous macroblock;
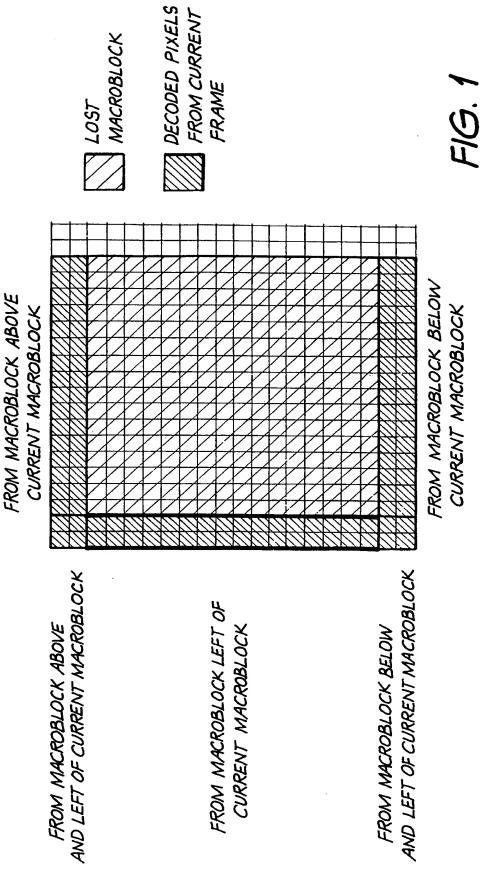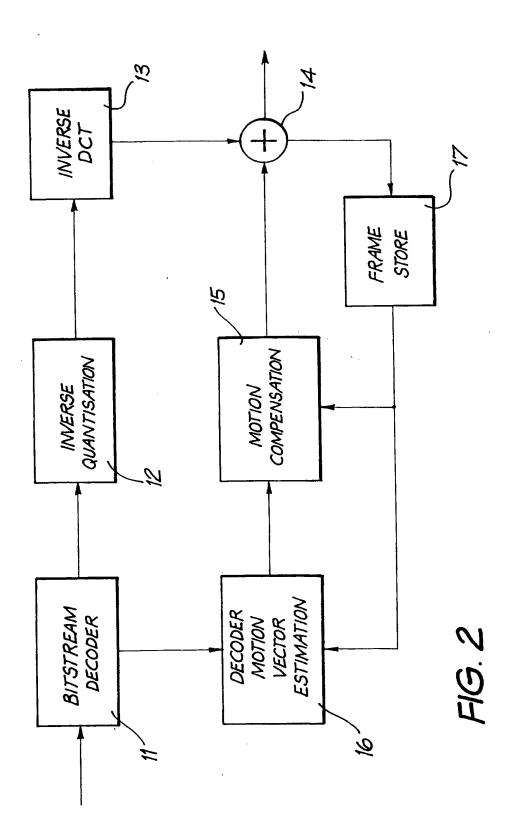
ii) scanning a previous picture of the secondary signal to locate a secondary tag region substantially identical to each primary tag region of the current picture;

iii) generating error concealed macroblocks of the current picture of the secondary signal by identifying a substitution macroblock located in the same relative location with respect to the secondary tag region as the erroneous macroblock of the current picture of the primary signal is located with respect to the primary tag region; and

iv) copying the substitution macroblock to the macroblock in the current picture of the secondary signal corresponding to the respective erroneous macroblock in the primary signal.

29.   The method of claim 28 wherein the video signal processing means first generates in the secondary signal those macroblocks that are error free in the primary signal.

30.   The method of claim 29 wherein after the video processing means has produced the error free regions, it identifies tag regions in the primary signal relative to each error containing macroblock.

31.   The method of claim 30 wherein for each tag region a corresponding tag region is identified in the previous picture of the secondary signal, and a region relative to each tag region is identified as the motion compensated predication of the respective error region of the current picture of the primary signal.

32.   The method of claim 31 wherein for each tag region the motion compensated prediction of the corresponding error macroblock is determined before identifying the next tag region.

33.   The method of claim 31 wherein all of the tag regions are identified before any of the motion compensated predictions are determined.

34.   The method as claimed in any one of claims 28-33 wherein the error containing macroblock is divided into a plurality of subregions, each having a corresponding tag region and a separate motion compensated prediction being determined for each error containing macroblock.

5   35.   The method as claimed in any one of claims 28-34 wherein each tag region is immediately adjacent to the respective error containing macroblock.

36.   The method of claim 35 wherein each tag region comprises one or more rows of pixels along one or more edges of the respective error containing macroblock.

FIG. 1

LOST MACROBLOCK

DECODED PIXELS FROM CURRENT FRAME

FROM MACROBLOCK ABOVE CURRENT MACROBLOCK

FROM MACROBLOCK BELOW CURRENT MACROBLOCK

FROM MACROBLOCK ABOVE AND LEFT OF CURRENT MACROBLOCK

FROM MACROBLOCK LEFT OF CURRENT MACROBLOCK

FROM MACROBLOCK BELOW AND LEFT OF CURRENT MACROBLOCK

FIG. 2

INTERNATIONAL SEARCH REPORT

A.	CLASSIFICATION OF SUBJECT MATTER

Int Cl⁶: H04N 5/937, 7/30, G06T 5/50, 9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B.	FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: G06T, H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: (Video or MPEG or H. 324) and (stream or process: or compress:) and (error or errors or noise or loss) and (motion or interframe or predict: or interp:) and (tag or region or block or transform) and (correct: or detect: or componsat: or conceal: or identif:)

C.	DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 727910 A (THOMSON MULTIMEDIA) 21 August 1996 Whole document	1-36
A	EP 471580 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 19 February 1992 Whole document	1-36
A	US 5442400 A (SUN et al) 15 August 1995 Whole document	1-36

☐	Further documents are listed in the continuation of Box C	☒	See patent family annex

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 September 1998	**1 3 OCT 1998**

Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **J. LAW** Telephone No.: (02) 6283 2179

INTERNATIONAL SEARCH REPORT

Information on patent family members

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	727910	CN	1141561	JP	8256311	US	5621467
EP	471580	DE	69125547	JP	4098987	KR	9511818
		US	5416600				

END OF ANNEX